measures is obtained, the British system will drop out of existence as a natural consequence of the elimination of the unfit. Prof. Wagstaff not only describes clearly the metric measures, but he also brings together a number of facts and expressions of opinion for and against their introduction into the British Isles.

The Aurora Borealis. By Alfred Angot. Pp. xii + 264. (London: Kegan Paul, Trench, Trübner, and Co., Ltd., 1896.)

THIS is a translation of a book—"Les Aurores Polaires"—reviewed in this column in March 1895 (vol. li. p. 484). It is the eighty-first volume of the International Scientific Series, in the list of which it is correctly entitled "The Polar Aurora," instead of "The Aurora Borealis." Only upon the title-page and cover does the latter designation appear, each of the pages with even numbers bearing the former title. This inconsistency will probably lead to some confusion.

A comparison of the present volume with the original edition shows that the translation has been well done. We have, as the result, an interesting and lucid account of the present state of knowledge of the aurora in all its aspects, illustrated by pictures of the typical forms assumed. In an appendix, a list is given of the auroræ seen in Europe below latitude 55° from 1700 to 1890.

An index would be a valuable addition to the book.

Ros Rosarum: Dew of the Ever-living Rose. Pp. xxix + 292. (London: Elliot Stock, 1896.)

A SECOND edition has been issued of this delightful little volume. It contains extracts from works of poets whose songs have come down to us from all ages. In the interesting introduction the author states that many of the translations are due to the kindness of Lord Tennyson, Lord Lytton, Mr. J. A. Symonds, and many friends. Much information is also given concerning the history of the rose, and it is shown how highly this flower has been regarded at various times and in various countries. In both Athens and Rome it was recognised as the queen of flowers; there seems, indeed, to have been scarcely a time when it was not valued and appreciated. The book will be found very interesting; the quotations have been carefully collected and placed, as far as possible, in chronological order. It may also be added that one quotation from Lord Tennyson is not to be found in his collected works, a fact which adds interest to the little volume.

Knowledge. Vol. xix. January to December 1896. Pp. 288. (London: *Knowledge* Office.)

WE offer our congratulations to the editor of *Knowledge* upon the completion of this very attractive volume. The illustrations—many of them full-page collotypes—are most instructive pictures, and the figures in the text are just as good. The remarkably fine reproductions of astronomical photographs are particularly interesting. A series of twelve well-illustrated articles by Mr. Vaughan Cornish, under the comprehensive title of "Waves," also calls for special mention. It is not possible to keep up with the march of science in a monthly periodical; but *Knowledge* gives a good general idea of progress, and the present volume is full of interesting articles on comparatively recent work, illustrated by some of the best pictures it is possible to obtain.

Hygiene Diagramettes. By W. H. Knight. (London: Chapman and Hall, 1896.)

THIS is a collection of twenty-four photo-zincograph reductions from large diagrams designed for teaching hygiene. Upon the page facing each of the illustrations are given brief descriptions of the separate drawings and tables. These notes, together with the instructive diagrams, should be very serviceable to teachers and students. It is a pity that the inscriptions attached to some of the illustrations are illegible, owing to the reduction of the originals having been carried too far.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Leonids of November 15, a.m., 1896.

THE display of Leonids on the morning of the 15th ult. was observed here under very favourable conditions of the sky for noting the progress of the shower in numbers and in brightness, and in the position and distinctness of the meteors' radiant-point or centre of divergence. As observations of this kind collected in the present early stages of the shower's gradual increase to greatest brilliancy seem likely to be very useful to improve our knowledge of the past history and mode of advent of this meteor-stream into the solar system, I send the following leading particulars of the shower as it was here observed.

The sky was cloudless during my watch from midnight until dawn appeared rapidly at six o'clock on Sunday morning, the 15th, excepting only in the hour from 4½ to 5½ a.m., when clouds spreading slowly hid nearly all the sky in the latter half of the hour, but dispersed quickly then in time for a perfectly clear half-hour from 5½ a.m. till daybreak. At this latter time the radiant in Leo, then preceding the mean sun as it did, about six hours in R.A., had reached its highest southern altitude of a little over 60°, or nearly that of the sun at midday in midsummer, while in the hour from midnight to 1 a.m. it was, like the sun in June-July at 6-7 in the morning, 20° to 30° above the E. by N. horizon, having risen above the horizon in that quarter a few minutes after ten o'clock. The moon, however, a little past her first quarter, shone strongly still in the west, hiding 5th magnitude stars till one o'clock, and only set, leaving the sky quite clear, at about 1.45 a.m. It may be owing to the obstacles of clouds in one, and of moonlight in another hour of the watch, that only one Leonid was recorded in each of the two hours from 4½ to 5½, and from 12 to 1 o'clock; but observations made elsewhere under better sky conditions, by Mr. W. H. Milligan in Belfast, and by Mr. H. Corder at Bridgwater,[1] show that there were really lulls in the shower's intensity before 2, and towards 4 o'clock, though it regained its brightness in the later hour from 5 to 6 o'clock; and neither the comparatively low altitude of the radiant-point, nor the moderate strength of moonlight till 2 o'clock seem sufficient to account satisfactorily, considering the brightness of most of the meteors which showed themselves very little later, for the marked scarcity of Leonids noted in the first two hours of the watch. The following numbers of Leonids and of sporadic or non-Leonid meteors were recorded (and most of their apparent paths were mapped) in the successive hours (or half-hours) ending at

	1	(1½)	(2)	3	4	(4½)	5½	(6) a.m.	
Numbers of Leonids ...	1	1	2	11	7	5	1	6;	Total, 34
Numbers of Sporadic Meteors	—	—	2	3	4	1	1	1;	,, 12
Ratio of Leonids to Sporadic Meteors, nearly 3 : 1.									
Hourly Numbers of Leonids	1	2–4		11	7	(10)	[*2]	(12);	[*, cloudy].

Meteor-magnitudes.								
Equal to	♀	♃	Sirius	1st	2nd	3rd	4–5th.	
Numbers of Leonids ...	1	4	2	6	8	8	5;	Total, 34
Numbers of Sporadic Meteors	—	—	—	—	1	2	9;	,, 12

The second table shows how much the Leonids surpassed in brightness, as they also did in numbers, the ordinary appearances of shooting stars on a November night. The brightness of the display, and its rather sudden commencement, apparently at about 2 o'clock on the morning of the 15th inst., seem to point to that morning as having been at least a very conspicuous date of its return this year, although eager expectation of a shower on the morning of Saturday, November 14, was awakened in the preceding days by ably written articles on the phenomenon in the leading daily journals, which could not be fulfilled and realised in England from the unfavourable state of the atmosphere for observations.

---

[1] *English Mechanic*, November 27, 1896:—"From 12½ to 2" (? Irish time, = 1–2½ English time) a.m., Mr. W. H. Milligan noted "9 Leonids; hourly number about 6." This was a rather low rate of appearance in that period. Mr. Corder began watch at 2 o'clock, and saw eight Leonids and two sporadic meteors in the first half-hour, "after which the numbers fell off; but when the radiant had risen higher, about 5 to 6 o'clock, 16 meteors were seen in an hour, nearly all Leonids." Descriptions of the shower's appearance on the preceding morning (of November 14), by Mr. Corder and Mr. E. R. Blakeley, in the same issue of the *English Mechanic*, and descriptions of the apparent paths of several bright Leonids seen in a clear hour at daybreak on November 15, by Mr. W. E. Besley, at Walthamstow, in the next preceding number of the same journal (November 20), are extremely interesting in this connection, and will presently be again referred to.

The earth should indeed have crossed the main meteor-stream of the two great showers of 1866 and 1867, supposing the node of the meteor-current's orbit to have been advancing at its accustomed pace on the ecliptic in the intervening years, at about daybreak, or between 3 and 9 o'clock a.m. on Saturday morning, the 14th, as predicted; but certain attendant meteor-clouds or clusters also exist, accompanying the main stream, and on 1865, November 13 (a.m.), a grand display of the Leonids was widely observed in Europe and America from midnight until daybreak, which, it was shown by Mr. B. V. Marsh[1] of Philadelphia, U.S.A., constituted a branch-stream twelve or fifteen hours earlier in the times of its maximum recurrences than the principal meteor-stream of the two great November-exhibitions of the next two years. And again, near Pekin in China, on November 15 (a.m.), 1867, and in America on November 14 (a.m.), 1868 (agreeing also with showers observed in England on November 14 (a.m.), 1868, and November 15 (a.m.), 1871[2]) bright showers of Leonids scarcely inferior to the main stream's apparitions were witnessed, which, as was pointed out at the same time by Mr. Marsh, belonged to a branch-stream following the main stream, instead of preceding it, by about the same time of between twelve and fifteen hours as the other one, in its appearances. The Leonids of the 15th ult. appear thus to have appertained to this following branch-stream which the earth was probably passing through with sensible sparse gaps and condensations, for about 14 hours (according to its formerly observed durations) between dusk and daybreak on the night of the 14th–15th ult.; and if the two following and preceding side-streams are equally long, evenly extended belts with the main stream of meteoric matter, it may perhaps be expected that on the mornings of November 14 and 15 next year, the earth will come to be immersed in the preceding and following meteor-belts, respectively, while the main current encountered like the fellow-streams, six hours later than their predicted times this year will be traversed in the daytime of November 14, 1897, producing a principal meteor-shower then which in the full daylight will not be visible in England. In the years 1899 and 1900, on the other hand (the latter year a non-leap year), it seems probable that the brief but imposing scene of the earth's passage through the main stream, if no disturbances in its path since 1866-7 have warped the current out of its expected course, will occur more opportunely and more favourably for English watchers about at midnight and at 6 o'clock a.m. respectively, and one or both of them perhaps in pretty full completeness, on the mornings of November 15.

The general colour of the heads and streaks of the Leonids seen on the 15th ult. was dull yellowish white, or yellow, but some of the largest had bright white nuclei with white streaks. The head of one very fine one only, at 5.58, was slightly greenish, when brightest; but the long and broad dense streak which it left visible for 6 seconds, was of the same golden yellow colour as that which prevailed in the fainter streaks of ordinary durations (2-4 secs.), and of ordinary lengths (10°-20°), and which was now and then seen most distinct and vivid in the spindle-shaped foreshortened streaks left near the radiant point. This green and yellow-tinted meteor, brighter than Jupiter, and the last which I observed, shot through 40°, overhead across the dawn-lit sky, from the direction of κ *Leonis* so exactly to β *Aurigæ*, and directed there towards *Capella*, that that bright star-pair, prolonging the line of the streak's golden wand, as it appeared, which just reached the former star, looked with the streak like a grand jewelled sceptre in the sky, whose long staff only slowly faded.[3]

Fine meteors leaving streaks along their whole path-lengths for four or five seconds appeared at—

Hour.	Mag.	Apparent path		Path-length and duration.		Streak; Appearance; and Remarks.
		From	To			
a.m.		° °	° °	°	s.	
1.54	> 1	152 + 52	210 + 89	40	1½	
2.2	♃	45 + 67	352 + 36	40	1⅓	
2.29	> 1	70 − 3	54 − 10	20	¾	Low in S.W.
2.33	♃	134 − 10	132 − 16	6	¾	Low in E.
3.6	Sirius	100 + 8	82 − 1	20	¾	In S.; white streak.
3.11	♀	22 + 14	17 + 9	6	1¼	In W.; (approx. path.).
3.12	Sirius	26 + 45	6 + 25	25	1·0	In W.; white streak.
4.14	♃	165 + 10	176 + 44	35	1¾	From μ Hydræ (?); white; with broad white streak for 6 secs.
4.45(?)	> 1	173 + 9	179 + 4	8	1·0	
5.58	♃	135 + 30	87 + 45	40	1½	Long yellow streak for 6 secs.

Seen also apparently, at Walthamstow, by Mr. W. E. Besley, with the following description, and positions:—

5.59	2	141½ + 23	95 + 22	43	—	(The *English Mechanic*, November 20, 1896.)

The meteors nearly all moved very swiftly, and described their paths, in general, at rates of about 10°–15° in half a second.

Much careful selection was needed from the mapped paths of the Leonids to obtain a satisfactory position of the radiant-point, as quite a volley of fine long-pathed streak-leaving meteors from a radiant, apparently in *Crater* or *Hydra*, far south of *Leo*, streamed in direction across *Leo* and *Cancer*, surpassing the Leonids in speed, brightness of the heads and streaks, and lengths of path, and frequently confusing themselves with the cometary shower as if they were exceedingly erratic members of it. One very resplendent one, whiter and brighter than Jupiter, set out, at 4.14 a.m., exactly from Jupiter in the middle part of *Leo*, and shot swiftly up across θ, δ *Leonis*, 35° to near the hindermost foot of *Ursa Major*, leaving a dense white streak 5' broad for about six seconds all the way—a path which it would be difficult to reconcile with a radiant point near *gamma Leonis*, although the meteor in all respects, except in its globular white head, exactly resembled a Leonid. A position is given for December in Prof. Heis' and Dr. Neumayer's "List of Southern Radiants," of 1867,[1] at 148°, − 34°, which although much further south than one near λ *Hydræ* at about 150°, − 12°, which seemed to be active on the 15th ult., yet shows that there are showers with southern declinations at this time of the year near the meridian of the shower from *Leo*, almost as oppositely directed (and consequently as swift) in their motions as the Leonids are, to the motion of the earth. The meteors of the 15th ult. and of a few neighbouring nights, also showed signs of radiation from near δ, or α and κ *Cancri*, at about 137°, + 17°; and on a chart of meteor-paths recorded last year on the mornings of November 13–15, I find four long-pathed tracks traced back to a common radiant-point at 132°, + 17°, near δ *Cancri*, which they fitted well, and which perhaps confirms this place.

Omitting then as doubtful Leonids for this reason (or else for their distances from the chief focus of the radiation), out of the thirty real or possible Leonids mapped, all but those whose courses' prolongations backwards would cross the small area of the sky formed by completing the circle half traced by stars in *Leo's* sickle, the twenty-two paths remaining, all diverged from a circular tract 10° in diameter, having a point at 148°, + 23°, near the small star *x Leonis*, at its centre. But a circle only 6° in diameter, round a centre at 149° + 24°, also includes nineteen of these tracks very evenly distributed, if three at the south-west border of the larger circle are omitted; and accordingly this latter point, still very near to *x Leonis* in the middle of the sickle, was a very well defined and exactly marked centre of the shower's radiation, since nineteen out of thirty, or 63 per cent. of all the tracks of possible Leonids recorded, proceeded from within 3° or 3½° from it, outwards towards all directions.

---

[1] British Association Reports, 1869, pp. 302–3.

[2] *Ibid.*, 1872, pp. 96–7. See also 1866, pp. 64–5 and 137.

[3] Had I provided myself with a hand-spectroscope for this occasion, this meteor's streak and a few of the most enduring ones left by the brightest meteors of the shower, would doubtless have presented very interesting features for spectroscopic study. By comparison with the sky-positions recorded of this meteor's apparent path at Walthamstow by Mr. Besley, a real path of the meteor is obtained by the base line of 28 miles W.S.W.–E.N.E. between the stations, from 90 miles over a point on the border of Sussex and Hampshire, halfway from Midford to Alton, to 27 miles over a point 5 miles east from Didcot, directed from a radiant point at 150° + 22°, then 60° above the S. by E. horizon; the length of the sloping path being 74 miles, which the meteor described, as was noted here, in 1½ second. The beginning and end heights, and the speed of flight thus indicated by the calculation of nearly 50 miles per second, not surpassing much the real meteor-speed—43 miles per second—of the Leonids, lend much probability of correctness to the view adopted here, that though differing in the apparent magnitudes, and somewhat in the estimates, as described, of the path's apparent lengths at the beginning and end points, the two accounts at Walthamstow and Slough really referred both to the same bright long-pathed shooting-star seen to begin its course at both the stations in remarkably close proximity to a radiant-point almost identical in position with the principal one on that night in Leo. Seven meteor paths of Leonids were mapped in the hour from 5.38 to 6.42 a.m. on November 15, by Mr. Besley, of 1st–3rd magnitudes, and the last of them in strong-growing daylight, as bright as Jupiter. This bright white one, and three others, all beginning in and near Leo's sickle, diverged almost accurately from a common point at 149° + 22°, the remaining three only deviating, in respect to radiation, from 4° to 8° from that position.

[1] British Association Reports, 1868, pp. 405–6.

The chief apparent wandering from this centre shown by the eleven erratic-flighted Leonids was south-westwards, towards α, κ *Cancri*, where seven of those outlying tracks (including the three wide-circle-grazing path-lines) are loosely collected; but of these seven, some may have belonged, as was surmised above, to contemporaneous sparse showers at about 135°, + 17°, and 150°, − 12°; and as the four paths which strayed north-eastwards from the sickle, though forming a fan-like group roughly focused at about 155°, + 35°, near *f, g Leonis Minoris*, were no doubt Leonid stragglers, shooting in proper numbers for their own half of a field supposed to be about evenly strewn with them, from no really existing radiant centre there, there would thus seem to have been among the strayed Leonids themselves no tendency that could be noticed to move in side-flows and tangent-streams presenting laterally drawn-out and branching radiations strong or distinct enough to be discernible. No such lateral dispersions or divisions, therefore, seemed, from all the tracks' projections, to have affected the shower's radiation with any perceptible apparent changes from the very exactly defined centre, with even, and not very great dispersion round it, which has been usually observed as a strikingly conspicuous feature of this star shower's radiation at its principal returns.

Positions of this after-shower's radiant-point, obtained formerly and in the present year, are not in very perfect, although in fair general accordance; as even in its bright display of November 14 a.m., 1868,[1] places were assigned to it, at Rome, "at the centre of the five stars of Leo's sickle" (149½°, + 22½°) at Moncalieri, Piedmont, "exactly between γ and δ, ζ *Leonis*" (153°, + 22°), and at Madrid, "close to η *Leonis*" (150°, + 17°; mean of these places, 151°, + 20½°). In NATURE, November 30, 1871, a description of the shower's appearance in England on the morning of November 15, 1871, assigns the radiant-point's position from twenty-six Leonid paths as "not very well defined, but approximately close to ζ *Leonis*" (152°, + 24°). On the morning of November 15 in the present year, Mr. Corder obtained a position of 150°, + 24°, from forty-three Leonids; and four of the seven paths mapped at Walthamstow at daybreak on that morning by Mr. Besley (see note on p. 174) diverged accurately from 149°, + 22°—all slightly onward in R.A. from the principal radiant-point in Leo at 148°, + 23°; but the positions are too slenderly consistent to make this small difference appear to be of very much importance.

In a watch for the Leonids, from 4 to 6 a.m. on the 15th ult. at Bristol, Mr. Denning mapped the apparent paths of ten Leonids and five sporadic meteors. Three of the Leonids (one of them a foreshortened flash as bright as Jupiter) diverged accurately from 150°, + 23°, the other seven (also including one as bright as Jupiter) being directed eastwards from the lower part of *Leo's* sickle-circle. Of the three true-pathed Leonids, a small, very foreshortened one, of 3rd mag., leaving a streak, which fell at 5.45 a.m., about 2° from η down the sickle-handle, was also seen and mapped at Slough, at 5.44½, of 2nd mag,. leaving a streak for two seconds, but shooting through 12° in half a second to near α *Orionis* from the stars in the head of *Monoceros*, this path among the stars being from 50° to 60° removed by parallax (owing to the long base line of 84 miles, nearly due east and west, between Slough and Bristol) from the short course in *Leo* which it seemed to have from Mr. Denning's place of observation. The meteor's real path was found to be from the mean radiant-point of the shower at 150°, + 23° (then about 60° high above the S. by E. horizon), shooting steeply down through 24 miles, from 70 miles over a point 8 miles south, to 50 miles above a point 7 miles W.N.W. from Blandford, in Dorsetshire, the earth-point of this course being near enough to Bristol (about 20 miles south) to give a nearly end-on view there of the swift flight, subtending only 2°, while at Slough, where the flight was seen breadthwise, though more distant there than from Bristol, it subtended an arc in the sky of fully 12°. The computed speed of flight, 48 miles per second, although certainly terrific, does not exceed the known meteor speed of the Leonids, 43 miles per second, very greatly. One of the sporadic meteor-paths observed by Mr. Denning was directed from the vicinity of λ *Hydræ*, and the other four apparently from *Gemini* or *Taurus*, and from *Ursa Major*.

A fairly satisfactory comparison of this year's observations of the Leonids with the views obtained of them last year, although much frustrated by the cloudy weather which prevailed in England on those nights, in both years, when the earth's passage through the densest part of the meteor-system was expected, may be made rather scantily, but perhaps not insufficiently to show the increased intensity of the display this year in its gradual progress onwards towards its maximum The subjoined figure was prepared to assist the recognition of the separate streams of which returning signs have no doubt been visible in some of the present year's and of the last two years' watches. The relations of the leading and following side-showers, *a* and *b* in the figures, to the central one A, in duration and separation-distance, are supposed to be as shown by Mr. Marsh's similar projection in a figure[1] of the chief showers in 1865–68; for the leading showers, 12 hours, ending 6½ hours before, and for the following shower, 13½ hours, beginning 6 hours after the limits of the middle-shower's duration, whose entire range, in time, on the ecliptic also only reached 4½ hours for the two tracts together in which the earth there met with and passed through the middle stream in 1866–7.

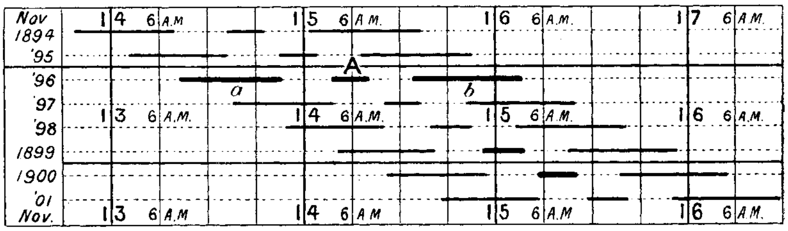

FIG. 1.—Probable times of recurrences of the Leonid meteor-shower and of its lateral branches, in the recent and coming years, 1894–1901; assuming the node of the meteor-orbit to have moved since 1866–7 with its observed and calculated mean motion.

The central stream's node on the ecliptic is also supposed to have been constantly, and to be still advancing at the mean rate, found for it by Prof. Newton and Prof. Adams, of 28′ or 29′ from a fixed, or of 57′ from the mean movable equinox, in each complete period (33¼ years) of the stream's revolutions; so that the earth returns to the meteor-node in 41½ minutes more than a true tropical year (amounting to 23 hours in a meteoric cycle), and in 30½ minutes more than a mean Julian year. The Leonid showers thus recur in successive years, as the figure shows, 6½ hours later in each year than in the previous year; but the 6 hours in this amount are corrected every fourth year, as in the present leap-year, by the supernumerary day, and only the half-hours accumulate in long times, and made the return of the after-stream *b* this year fall 14¼ hours later, on November 14, than its appearance 28 years ago, in 1868[2] (for 13 or 14 hours, from near midnight in Europe until after daybreak in America) on the morning of the 14th then; and even shift its time of appearance into lasting on now, apparently through all the morning hours of November 15.

No striking exhibitions this year of either the middle or the preceding showers A and *a* appear to have been noted At Slough, on the morning of November 13, only one true-pathed Leonid, with two from Cancer and Hydra, and three sporadic meteors were recorded in a sky half-clear, from 2 to 4 o'clock. In a watch of two or three hours on the same morning at Bridgwater, Mr. Corder noted twenty meteors, at a rate of eight per hour, and only five of these, or about two per hour, were Leonids. On the morning of the 14th, when the sky in England was generally overcast, similar numbers were observed; by Mr. Corder, in a sky often foggy, thirty-three meteors being seen at the rate of 8–13 per hour, of which only a small proportion still were Leonids, and by Mr. Blakeley at Dewsbury, who noted, from 12 to 4½ a.m., with two hours of quite clear sky at last, forty meteors, never appearing faster than fourteen per hour, among which were twelve Leonids with an hourly rate never exceeding six. Four or five of the Leonids were very bright, and their radiant-point was well defined at 150°, + 24°; but the whole display fell considerably short in brightness of that observed in 1895.[1]

---

[1] Reports of the British Association, 1869, pp. 293–4.

[1] Given in the discussion of those showers by Mr. B. V. Marsh, already cited above, in the Reports of the British Association, 1869.
[2] *Ibid*, 1869, pp. 289–94.

Perhaps the three close-following meteor-showers may all have fallen a little later this year than the figure represents them; but the first few hours of watches on the mornings of November 13 and 14 should at least, as the diagram shows, have been (as they were) both slenderly productive times, while a bright meteor-shower should have prevailed (as it did, rather vividly) on the morning of November 15. On last year's November dates the case was different, a rather bright array of Leonids being seen on the morning of November 14, followed by a smaller one on November 15, while after the latter date a generally clouded state of the sky in England prevented further observations. At Bridgwater, on November 14, Mr. Corder mapped eleven Leonids between 2 and 4¼ a.m., and found their radiant point at 152°, + 23°. Five or six Leonids were recorded here between 12 and 3 a.m. on that morning, with a radiant-point at 151°, + 23°, to which were also traced the paths of two Leonids mapped between 1 and 2½ a.m. on the next morning of November 15, when the shower seemed to be passing off, and when clouds on that and in the next night's watch prevented a complete view of the shower from being obtained at Bridgwater, and generally in England. The spectacle was thus most prominently seen last year on the mornings of November 14 and 15, while it was this year most conspicuous on the morning of November 15; and this agrees with this trial-figure's indication that the early and middle branches of the shower should have occurred at favourable morning hours on November 14 and 15 last year for English observations; but at such late hours this year, as to be only weakly visible in a few slight foretokenings on November 13 and 14, compared with the full brightness of the after-shower brought into view on the morning of the 15th by the same advance in hour together of all the three members of the triple concourse. If the present positions and durations, then, of these component showers may be assumed to have been depicted in the figure with approximate correctness, a full view *of the end* and middle portions of *the first* shower beginning to appear in the next two years, 1897 and 1898 after midnight (a.m.) on November 14, will afford means of comparing in strength and brightness those phases of the leading shower with *the middle and early parts* respectively of the *after*-coursing one, then still well visible on November 15, to gauge their relative extents in length and width, and the relative looseness or compactness of their structures, which may perhaps not offer themselves again so favourably for some years.

It will also be very useful in coming years' watches for these detached clouds of fragments from the meteor-comet, to note exactly the hours of the watches kept, the states of sky and moonlight, with the numbers and brightnesses of the Leonids and sporadic meteors seen, to enable a true distinction to be drawn between bordering diffuseness of the streams, and really distinct branch-currents or offshoots from the meteor-cloud; for between 4 and 6 a.m. on November 17, and from 2 to 5 a.m. on November 18, last year, Mr. Corder found true-pathed Leonids almost as numerous (11 out of 22 meteors, and 8 out of 30 meteors) compared with the sporadic shooting-stars, as on November 14 (11 out of 26 meteors), from 2 to 4 a.m.; while on the previous morning of November 13, from 2 to 4½ a.m. only 3 or 4 Leonids were seen among 18 meteors; showing that both gaps and condensations reaching to considerable but as yet not fully determined distances from the main streams exist to either side of them, of which the extents and the changes, or the fixity of distribution would be very interesting particulars of their modes of assemblage to endeavour to trace out by observations.

On the morning of the 27th ult., in clear sky, between 1½ and 3 a.m., seven small meteors were recorded here, two of which, of 1st and 2nd mags., and orange colour, at 2, and 2.42 a.m., between ι and ο *Honorum*, radiated with short slow courses from between β and δ, and from near γ *Andromedæ*, and were evidently fore-shortened Andromedes; but the first of them, at least, was quite as erratic from the true centre, near γ *Andromedæ* of the Bielan shower, as the tracks through *Cancer*, *Hydra*, and *Leo Minor* of the recent showers of Leonids have been from their native shower's true radiant-point. The horary scarcity of these small Andromedes on their annual date this year, showed that no brisk Biela meteor-shower was then in active progress. On the two evenings immediately preceding and following this short morning watch, the sky here was quite overcast.

A. S. HERSCHEL.

Observatory House, Slough, December 9.

The Force of One Pound.

DR. LODGE has some right to complain of the friendly post-card. I wanted the *Poundal* difficulty to be threshed out in public, and we had just been writing to each other about it, but I quite forgot that my post-card might give him the wrong notion that my general remarks referred to him. Dr. Lodge knows that the real question before us concerns the Poundal; he knows that his advocacy of it has helped to maintain that unit in its academic position, and yet he now leaves its defence to others. He professes his love for all units, and attacks the poundalists and the poundists impartially, for suggesting adherence to any system in particular. This is better than his own maintenance of the Poundal, and I hope that it presages a complete change of front. His maxims are of the best: "Urge clearness of idea and accuracy of speech on all who deal with the junior student. These should not call different things by the same name . . ." But what if they continue to do so? He himself often uses *velocity* when he only means *speed*.

A pound of force, a pound of stuff, the inertia of a pound; here are three very different things all with the same name. When the chemist tells us that there is the same quantity of matter after as before chemical combination, what does he mean? He means that the *weight* of it is the same; the force of attraction by the earth. A certain amount of oxygen is equivalent in a certain property (its weight), to a quantity of hydrogen, and he says that he will call the quantities equal. Certain quite different amounts of them are *equivalent* in another property; he has exactly the same reason for calling these other amounts equal. A ton of iron is equivalent in a certain property to two ounces of gold. Why not call these amounts equal?

A pound of gold is no more the same as a pound of iron, because their weights and inertias are the same, than two chairs are the same as one table because they may be equal in value. I hope that Prof. Fitzgerald may be induced to say something on this head, the "huggermugger" of confounding quantity of matter with inertia; for I think with him that this is what produces far more confusion in the minds of students than the use of many different units for things of the same kind. The practical engineer has uncommon good sense, he hates the Poundal, and I think that Prof. Fitzgerald is right when he says that it is not merely because it is a new unit, but because it is founded on "huggermugger." Let Dr. Lodge read Mr. Jackson's letter which followed his own. He will see that Mr. Jackson cannot comprehend how anybody can avoid using the pound of stuff as a fundamental unit, and how it must be innate perversity which causes engineers to adopt as their unit of inertia (or mass, as they have unfortunately to call it), the inertia of a body to which the unit force gives unit acceleration. This is the fruit of the Poundal; no doubt its inventor thought of inertia. Mr. Jackson thinks of quantity of stuff, which is a conventional or metaphysical idea.

The standard units of time, of force, of inertia; we can only keep them in indirect ways. Assuming that waste is prevented and that the weight and inertia of a certain body measured under the same circumstances at the same place are always the same, any standard body with proper comparing instruments gives us our standards of force and inertia. The instrument for comparing forces is ready to hand, a good weighing balance. There is no instrument which can be relied upon for comparing inertias, so we fall back upon an indirect method, assuming that inertia at any place is proportional to weight. But it is to be noticed that all our practical acquaintance with inertia and with what we call quantity of matter is based upon our measurement of *weight*, of

---

[1] The *English Mechanic*, November 27, 1896. At Funchal, in Madeira (1h. 8m. W. long. from Greenwich), Leonids were seen falling at the half-hourly rates of 6, 9, 6 in half the sky, from 4½ to 6 a.m. (about 5.40 to 7.10 a.m., Greenwich time), on November 14; the similar rates between 2 and 4½ a.m., in equally clear sky, having been only 3, 1, 1, 2 and 1 in half an hour.—Letter from Mr. W. Anderson, in the *English Mechanic*, December 11, 1896. *Note*, December 15.—A. S. H.